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SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 103 Washington: 1954 No. 3330

A REVISION OF THE GOATFISH GENUS UPENEUS WITH DESCRIPTIONS OF TWO NEW SPECIES

By Ernest A. Lachner

The most recent and comprehensive studies of the genus *Upeneus* were included in the faunistic reports of Herre and Montalban, 1928, Weber and de Beaufort, 1931, and Fowler, 1933. Six species of *Upeneus* were recognized by Herre and Montalban as occurring in the Philippine Islands, and Weber and de Beaufort recognized the same species in the Indo-Australian Archipelago. Fowler listed eleven species in his Philippine report but included five extralimital species, four of which are not valid or are highly questionable.

In all, 24 nominal species have been referred to the genus and much nomenclatorial confusion exists. The characters presented by the various authors to distinguish the species did not prove satisfactory in the identification of specimens in the U. S. National Museum from the same faunal areas. Additional specimens from the Philippine Islands and the Persian Gulf did not conform to any published accounts.

The object of this study is to determine the valid species in the genus and characters for their accurate identification, to evaluate the extent of interspecific differentiation, and to evaluate the population divergence in the various subfaunal areas.

Ten species are herein recognized, two of which are described as new.

The collections in the U. S. National Museum formed the chief basis of this study on which counts, measurements, and color analyses were made. These collections are listed by subfaunal areas of the Indo-Pacific region in the descriptions of the respective species.

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Specimens and types at the Museum of Comparative Zoology, Harvard University, were also examined. One specimen (*Upeneus subvittatus* Snyder, 1907, p. 101) was loaned from the Natural History Museum, Stanford University, through the courtesy of Dr. George S. Myers. The type of *Mullus dubius* Temminck and Schlegel (1843, p. 30) was reexamined for the author by Dr. M. Boeseman, Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.

I am also indebted to William C. Schroeder for making laboratory facilities available at the Museum of Comparative Zoology, Harvard University, and to Dr. Robert R. Harry, Academy of Natural Sciences, Philadelphia, for loan of the holotype of *Upeneus phillipsi* Fowler. The photographs were taken by personnel of the Smithsonian Institution's photographic laboratory.

The synonomy listed in the descriptive accounts of each species is incomplete. Many faunal studies were largely ignored except in cases where adequate descriptions or illustrations were presented, or where the collections involved were available for reexamination. The geographical distribution given for each species was constructed from the distributions of examined specimens and from the literature where the descriptions or illustrations were sufficiently thorough and accurate to enable me to identify the species with assurance.

All measurements of the length of a fish refer to the standard length, unless stated otherwise. The method of counting fin rays, gillrakers, and scales of the body is similar to that given by Lachner (1951, p. 581). In the first paragraph under "Description" of each species the count for each character is recorded as follows: the mean: range (number of specimens); for example, pectoral rays 16.1: 15 to 17 (68). This method of recording does not apply for the new species. For these, separate methods are given in the description of each species. Dark spots at the tips of the lobes of the caudal fin, distinct from black margins, were counted as bars in the tabulated data, but the small spots or blotches near the midbase of the caudal fin were omitted.

Diagnostic characters

Several of the important diagnostic characters useful in distinguishing the species have been misinterpreted by various authors or were entirely overlooked. It is necessary, therefore, to discuss the critical characters in the approximate sequence of their importance in the identification of the species. These characters are of taxonomic value because of their low variability and the accuracy by which they can be measured. The sequence in which they are discussed is not intended to portray phylogenetic relationships although this may partially exist.

The number of SPINES IN THE SPINOUS DORSAL FIN is either 7 or 8 in any particular species. Only one abnormally developed specimen of a species normally with seven had 6 spines. The difference of one spine among the species is associated with the presence or absence of the minute first spine. No variability was found in this character in any species in more than 300 specimens examined. This small spine is located near the first enlarged one, often partially embedded, and may be entirely overlooked without employing some probing and a microscope. The variability of this character as given by Fowler (1933, pp. 322, 341) is erroneous.

Counts of the PECTORAL FIN RAYS for 10 species from various localities in the Indo-Pacific are given in table 1. The range of this character in any species did not exceed four rays. An inspection of the data in the table shows that the species are divisible into two groups and that the modes of the frequency distributions fall on 13 or 14 in one group and on 16 in the other, except for *U. parvus*, where only 6 specimens were available for study. It is unfortunate that descriptive accounts of certain nominal species did not include this character; with it, a more reliable interpretation would have been possible.

The TOTAL NUMBER OF GILLRAKERS of 260 specimens are arranged from lowest to highest, respectively, for nine species from the Indo-Pacific region in table 1. The tenth species, *parvus*, represents the single form in American waters. These data represent specimens from various localities. The range of this character for each species is low.

The usual count of the gillrakers reported in the literature is that of the lower limb only. The rudiments were seldom included. Sometimes they were partly included but without explanation as to how they were distinguished from the developed rakers, making it impossible to interpret the count. To form a more reliable basis for the interpretation of data in the literature, the raker count of both limbs and the raker-rudiment relationship are recorded separately in tables 2, 4, and 5. It is apparent from these data that the number of rudiments and rakers differs for different species and that the addition of developed rakers and rudiments of the upper and lower limbs to form the total count displays the greatest differences among the species.

Species having a minute first dorsal spine can be divided into two subgroups on the basis of the total number of gillrakers (see key, p. 508). The number of gillrakers in these two divisions also has a positive relationship to the number of pectoral fin rays.

The species are divisible into two groups on the basis of color of peritoneum: Those in which it is light to silvery (first four species and the last species, table 1), and those in which it is light brown to blackish (all other species, table 1). A positive relationship occurs

TABLE 1.—*Number of pectoral rays, total number of gillrakers, and length of chin barbel in 10 species of* Upeneus

Species	Number of pectoral rays							Total number of gillrakers													
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
luzonius			9	1				2	3	2	2										
arge		1	11							1	6	3	1								
oligospilus		5	7						1	1	6	3									
tragula	2	68	7							7	11	31	6	2							
bensasi		8	38									4	6	16	8	3					
asymmetricus		3	1													1	2	1			
moluccensis				3	14	2	1									2	7	6	2	3	
vittatus				4	52	12									2	16	27	15	6	2	
sulphureus				18	37	3									1	2	8	15	7	7	3
parvus				3	3										2	1	2	1			

Species	Barbel length in percent of head length [1]																			
	46 47	48 49	50 51	52 53	54 55	56 57	58 59	60 61	62 63	64 65	66 67	68 69	70 71	72 73	74 75	76 77	78 79	80 81	82 83	84 85
luzonius									1	3	1	3	1	1						
arge										1	1	2	2	3	1					
oligospilus			1			2	2	4	2	1										
tragula				4	4	3	14	14	10	6	1	2								
bensasi										1	1	4	7	4	5	10	1		1	1
asymmetricus							1			1	2									
moluccensis		1	1	3	4	2	6	1	2	1										
vittatus	1	2	7	7	13	9	16	10	5	3	1									
sulphureus							1	2	2	7	9	12	6	10	5	6	7	3	3	
parvus									1				1		2	1	1			

[1] Data refer to specimens of all sizes except in *U. sulphureus* where specimens less than 85 mm. in length were excluded.

between color of peritoneum and number of gillrakers (table 1) for the Indo-Pacific species but does not hold when the Atlantic species, *U. parvus*, is included. Indo-Pacific species with the peritoneum light colored have fewer gillrakers than those with dark peritoneal linings.

The COLOR OF THE PERITONEUM is a clear-cut character in most of the species and specimens. However, certain species show some variation and intermediacy and these may be difficult to evaluate, especially to one inexperienced with this character. Species with light or transparent to silvery peritoneal linings may have a few scattered, dark, pepperlike spots. Species with peritoneum colored light brown to blackish may in some cases have a silvery cast over a brownish background. This is especially so in *asymmetricus* and in some small specimens of *bensasi*.

A summary of the number of ROWS OF VERTICAL SCALES in 253 specimens and scales below the lateral line is given in table 2. The low intraspecific variability of the number of scale rows is evident in that the range does not exceed five for any species. The scales are somewhat deciduous and the count cannot always be made. Many large or poorly preserved specimens lack some or all of the scales. The number of scale rows has been widely used in the literature as a diagnostic character but interspecific differences have never been compared. The discrepancies between my data and that given in the literature may in part be associated with different methods of making this count. Others are not explainable.

Life colors are useful in the identification of the species but fade in preservation. However, certain brown to black stripes, bars, spots, and blotches on the body and fins persist in preservation in varying intensities. These COLOR MARKS are extremely valuable in distinguishing certain species, especially the number of oblique bars on the upper lobe, lower lobe, or both lobes of the caudal fin. In some species the number of bars increases with growth, whereas in others it remains constant. The variation and relationship of the number of bars in respect to size of body for three species is given in table 3. Failure to understand this character by various authors has caused considerable confusion in distinguishing the species (Fowler, 1918a, p. 37, fig. 15).

Average values of the LENGTH OF THE BARBEL show differences among the species, but great overlaps occur in the ranges (table 1). In at least one species (*sulphureus*) there may be an increase in the length of barbel with increase in length of body (see tables 6, 8, 9, 11).

Other characters such as depth of body, length of head, length of snout, and size of eye were investigated. Although small average differences were apparent among the species, they were too insignif-

TABLE 2.—*Number of vertical scale rows and scale rows below the lateral line, and number of gillrakers on each limb of the first arch in 10 species of* Upeneus

Species	Vertical scale rows											Scales below lateral line	
	28	29	30	31	32	33	34	35	36	37	38	6	7
luzonius	----	----	----	6	2	----	----	----	----	----	----	5	----
arge	----	----	----	----	----	----	----	----	----	6	4	----	6
oligospilus	----	1	7	3	----	----	----	----	----	----	----	11	----
tragula	2	14	16	12	4	----	----	----	----	----	----	37	----
bensasi	----	15	7	3	----	----	----	----	----	----	----	13	2
asymmetricus	1	2	1	----	----	----	----	----	----	----	----	3	----
moluccensis	----	----	----	----	----	2	5	3	3	----	----	----	8
vittatus	----	----	----	----	----	1	13	20	14	1	----	1	22
sulphureus	----	----	----	----	----	----	5	21	13	5	----	----	27
parvus	----	----	----	----	----	----	----	----	1	1	2	1	2

Species	Gillrakers															
	Upper limb [1]						Lower limb [1]									
	5	6	7	8	9	10	13	14	15	16	17	18	19	20	21	22
luzonius	5	4	----	----	----	----	2	5	2	----	----	----	----	----	----	----
arge	2	9	----	----	----	----	----	1	4	5	1	----	----	----	----	----
oligospilus	1	10	----	----	----	----	----	2	6	3	----	----	----	----	----	----
tragula	10	41	6	----	----	----	----	----	16	35	5	1	----	----	----	----
bensasi	----	8	25	4	----	----	----	----	1	6	18	10	2	----	----	----
asymmetricus	----	----	----	4	----	----	----	----	----	----	----	1	2	1	----	----
moluccensis	----	----	1	16	3	----	----	----	----	----	----	1	8	8	1	2
vittatus	----	----	4	53	11	----	----	----	----	----	1	14	34	17	1	1
sulphureus	----	----	2	26	14	1	----	----	----	----	----	3	8	20	10	2
parvus	----	1	1	3	1	----	----	----	----	----	----	2	4	----	----	----

[1] Raker at angle of arch omitted from counts, all rudiments included.

TABLE 3.—*Variation and relationship of the number of bars on the caudal fin with increase in body length in three species of* Upeneus

Length in mm.	Number of caudal bars on upper lobe—on lower lobe: [1]										
	2–2	2–3	3–3	3–4	4–4	4–5	5–5	5–6	6–6	6–7	7–7
21–30	2[1]	------	[1]	[1]	------	------	------	------	------	------	------
31–40	------	4	4	------	[2]	------	[1]	------	------	------	------
41–50	------	------	5	3	[1]	[1]	------	------	------	------	------
51–60	------	------	1	7	1	------	------	------	------	------	------
61–70	------	(1)	2	9	------	3	------	------	------	------	------
71–80	------	------	1(1)	5	2	4	------	[1]	[1]	------	------
81–90	------	------	(2)	2	4	5	------	------	------	------	------
91–100	------	------	(2)	3	1	6	3	1	------	------	------
101–110	------	------	(1)	1	1	5	------	1	[1]	------	[1]
111–120	------	------	------	------	(1)	3	------	1	------	------	------
121–130	------	------	------	------	(2)	3	------	------	------	------	------
131–140	------	------	------	------	(1)	3	------	------	------	------	------
141–150	------	------	------	------	------	3	1	------	------	------	------
151–160	------	------	------	------	(1)	------	------	------	------	------	------
161–170	------	------	------	------	------	3	------	------	------	------	------
171–180	------	------	------	------	------	2	------	1	1	------	------
181–190	------	------	------	------	------	1	------	------	------	------	------
191–200	------	------	------	------	------	------	1	------	------	------	------
201–210	------	------	------	------	------	------	------	------	------	------	------
211 and over	------	------	------	------	------	------	------	------	1	1	------

[1] Numbers in parentheses refer to *U. oligospilus;* those without enclosures, *U. tragula;* and those in brackets, *U. luzonius.* Following data not recorded for *U. tragula:* 1 specimen, 97 mm., 4 bars on upper lobe, 6 on lower lobe; 1 specimen, 107 mm., 3 bars on upper lobe, 5 on lower lobe.

icant or variable to be of any practical taxonomic importance. The basal rigidity of the barbel, used as a key character by Weber and de Beaufort (1931, p. 363), was not found reliable. The different lengths of the barbel among the species probably led them to misinterpret this character. Herre and Montalban (1928, pp. 96–97) distinguished between groups of species by the presence or absence of preorbital scales. While this character may be of some value, great errors in the identification of the species can result since these scales as well as those on the head and body are somewhat deciduous in most species. The size and number of intestinal loops and the number of pyloric caeca were studied but poor preservation of these structures made it impossible to evaluate their taxonomic significance.

Group relationships

The species are divisible into two groups in three different ways by using a single character or combinations of characters. The first method, based chiefly on the absence of the minute first dorsal spine, separates *bensasi*, *asymmetricus*, and *parvus* from the remainder of the species, in which the spine is always present. These three species have little or no coloration on the dorsal fins (limited to light tan spots arranged in rows in *asymmetricus* and very faint bars in *parvus*), whereas the alternate group has the dorsal marked with bars or blotches, always very distinct except in *arge* and *luzonius*.

A second method includes the combination of the color of the peritoneum and the number of gillrakers. The Indo-Pacific species *luzonius*, *arge*, *oligospilus*, and *tragula* are related in having, almost always, light to silvery colored peritoneal linings, and fewer and shorter gillrakers. The remainder of the Indo-Pacific species have a light brown to blackish peritoneum, a higher number of gillrakers, and comparatively longer rakers. Of these species, *bensasi* is intermediate in respect to the number of gillrakers and *bensasi* and *asymmetricus* show the greatest variation in the color of the peritoneum. The Western Atlantic form, *parvus*, does not conform to this relationship in that the peritoneum is light but the gillrakers are numerous.

The third method, based on the number of pectoral fin rays (table 1), clearly indicates two groups of species.

Although the three methods are useful in identifying the species, the presence or absence of the minute first dorsal spine strongly suggests an ontogenetic change resulting in two phyletic lines on a subgeneric level of organization. I do not propose or advocate subgeneric terminology in a problem such as this where so few species are involved and where troublesome and complicated classification problems above the species level do not exist.

TABLE 4.—*Relationship of number of rudimentary and developed gillrakers on the upper limb in 10 species of* Upeneus

Species	Combinations of rudiments and rakers on upper limb [1]																									
	3, 2	4, 2	5, 2	6, 2	2, 3	3, 3	4, 3	1, 4	2, 4	3, 4	4, 4	1, 5	2, 5	3, 5	1, 6	2, 6	3, 6	0, 7	1, 7	2, 7	3, 7	0, 8	1, 8	2, 8	0, 9
luzonius	-----	-----	-----	-----	1	-----	-----	4	1	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
arge	1	-----	-----	-----	1	8	-----	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
oligospilus	1	5	-----	-----	-----	5	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
tragula	9	12	-----	-----	-----	25	2	1	1	3	-----	3	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
bensasi	-----	-----	1	1	-----	2	4	-----	3	17	1	3	3	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
asymmetricus	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----	-----	3	-----	-----	-----	-----	-----	-----
moluccensis	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	7	-----	-----	9	3	-----	-----
vittatus	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----	1	17	1	1	28	4	-----	8	4	-----	1
sulphureus	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	10	-----	1	15	10	1	4
parvus	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	1	-----	1	-----	1	-----	-----	-----	-----	-----	-----

[1] Numeral for the rudiment appears first in each column. Raker at the angle of the arch not included. When length of raker exceeded diameter of its base it was classified as developed raker, not rudimentary.

TABLE 5.—*Relationship of number of rudimentary and developed gillrakers on the lower limb in 10 species of* Upeneus

Species	Combinations of rakers and rudiments on the lower limb [1]																				
	9, 5	10, 3	10, 4	10, 5	10, 6	11, 3	11, 4	11, 5	11, 6	11, 7	12, 2	12, 3	12, 4	12, 5	12, 6	13, 3	13, 4	13, 5	13, 6	14, 3	14, 4
luzonius		2				3					2	2									
arge				1	1	1	2	3				1	1	1							
oligospilus	1			5	2	1	1	1													
tragula				6	4		8	19	1			2	10	4	1	2					
bensasi							1	2	3	2			3	7	1	1	4	3		4	1
asymmetricus																					
moluccensis																					
vittatus																			1	1	7
sulphureus																					2
parvus																					

Species	Combinations of rakers and rudiments on the lower limb [1]—Continued																					
	14, 5	14, 6	15, 2	15, 3	15, 4	15, 5	16, 2	16, 3	16, 4	16, 5	16, 6	17, 1	17, 2	17, 3	17, 4	18, 1	18, 2	18, 3	19, 1	19, 2	19, 3	20, 2
luzonius																						
arge																						
oligospilus																						
tragula																						
bensasi	2			3																		
asymmetricus								1	1			1	1									
moluccensis					2		1	1	2				3	3		2	3			1	1	1
vittatus	5	2	1	5	22	5	1	3	8	1	1		2	2								
sulphureus					1		2	1	3			1	4	4	2	2	11	7	2	1	2	
parvus					1			1					2									

[1] Numeral for developed raker appears first in each column. Raker at the angle of the arch not included.

Populations

No notable differentiation of any species in the subfaunal areas of the Indo-Pacific was revealed by an analysis of various meristic counts (see descriptions of *bensasi*, *vittatus*, and *tragula*, and tables 6, 10, and 11), proportional measurements, color, and color pattern of specimens segregated by locality. Differentiation in this genus appears to have gone to the species level, after which considerable stability was attained. These conclusions are tentative owing to the limited number of specimens of several species.

Although little is known of the life histories of these inshore forms, populations of such widely distributed species as *vittatus*, *sulphureus*, and *tragula* occurring in the subfaunal areas of East Africa, the East Indies, the Philippines, and areas of Oceania are assumed to be considerably isolated, yet they are characteristically homogeneous.

Larval forms of some species are thought to be pelagic, and their drift or movement may account for some minor association of these populations.

The genus is restricted to the tropical and subtropical, littoral, marine waters of the Indo-Pacific and Western Atlantic regions. The East Indies and Philippine Islands, near the center of the Indo-Pacific region, contain at least seven of the species, four are known from East Africa, four from Oceania, but only one (*arge*) is known in the Hawaiian fauna. Five extend northward as far as southern Japan and at least three reach eastern Australia. Only one species, *U. parvus*, occurs in the Western Atlantic area of American waters.

Genus *Upeneus*

Upeneus Cuvier and Valenciennes, 1829, p. 448 (type species, *Mullus vittatus* Forskål, designated by Bleeker, 1876, p. 333).

Hypeneus Agassiz, 1846, p. 190 (type species *Mullus vittatus* Forskål) (corrected orthography).

Upeneoides Bleeker, 1849, p. 64 (type species, *Mullus vittatus* Forskål, designated by Jordan, 1919, p. 240).

The characters best defining the genus are: (1) dentition complete, consisting of small villiform teeth on the vomer in the form of an irregular or triangular patch, on the palatines in an elongate band, and on both jaws in bands of narrow to moderate widths, and (2) scales present on soft dorsal, anal, and caudal fins. The bodies are elongate and somewhat compressed; the caudal fin is marked with dark, oblique bars in most species. The species attain a small size compared with other members of the family.

The following characters, some of which apply to other genera in the family, were found to be common to all the species: Anal fin rays I, i, 6: pelvic fin rays I, 5; caudal fin rays i, 7+6, i; scale rows around

caudal peduncle 16; scales ctenoid with 4 to 7 radii; lateral line complete; first elongate spine of first dorsal fin flexible; a small portion of barbel, less than one-third its total length, rigid at base.

Questionable species

I place two nominal species in a doubtful status, *Upeneoides sundaicus* Bleeker (1855, p. 411; 1877, pl. (4) 394, fig. 2) and *Upeneus taeniopterus* Cuvier and Valenciennes (1829, p. 451, type locality Trinquemale, Ceylon).

It is highly possible that *U. sundaicus* Bleeker may be represented by either *U. tragula* or *luzonius*. Bleeker's specimens were taken in the East Indies where both *tragula* and *luzonius* occur. Weber and de Beaufort (1931, pp. 370–371) saw one of Bleeker's specimens but their account, at least in part, was extracted from Bleeker. The account of *sundaicus* by Herre and Montalban (1928, p. 98) was "compiled from Bleeker, and Evermann and Seale" (1907, p. 88). Fowler's account (1933, p. 323) was also compiled from Bleeker. Examination of the specimen reported by Evermann and Seale as *sundaicus* (orig. No. 3201, USNM 56138) revealed a large, very poorly preserved specimen of *luzonius*. *U. luzonius* usually has weakly developed bars on the upper caudal lobe while those on the lower lobe may be completely obscure. Three dark saddles on the body are often completely faded. Such specimens, as well as large faded specimens of *tragula*, could easily have been involved in Bleeker's illustration. Yet, there still is the possibility of the existence of a species unknown to us. There is no method of solving this problem at present. Intensive collecting in the East Indies Islands, as well as study, is necessary. The characters listed for *sundaicus* by Bleeker and Weber and de Beaufort (dorsal spines VIII, the first spine minute, "gillrakers 13+3," barbels reaching "hindborder of preoperculum") clearly relate it with *tragula* and *luzonius*. The number of vertical scale rows that they report, 33 to 35, is higher than in these species, but this may be due to the different methods of counting. Only the bars on the caudal fin illustrated by Bleeker are unique but these may be highly diagrammatic. Therefore, *sundaicus* may be a synonym of *tragula*, may replace *luzonius*, or may represent a distinct species.

The second questionable form, *Upeneus taeniopterus*, known only by the type specimen, is characterized by having seven dorsal spines, each dorsal fin with three bars, each lobe of the caudal fin with six oblique bars, and a large triangular reddish spot on the caudal fin. Day (1876, p. 122) reported on the faded type and Fowler (1928, p. 227; 1933, p. 327) repeated Day. Steindachner (1901, p. 487) reported two specimens from Honolulu, but he probably had *U. argę*, the only member of the genus found in the Hawaiian Islands to date.

Key to the species of Upeneus

(References to groups of species in the descriptions pertain to all the species in the following categories of the key: 2a, *bensasi* group; 4a, *vittatus* group; 4b, *tragula* group.)

1*a*. Dorsal spines VII, the first spine longest.

2*a*. Pectoral rays number 13 or 14; vertical scale rows range from 28 to 31; peritoneum brown to silvery brown.

3*a*. Lower lobe of caudal fin without oblique bars, upper lobe with 2 to 3 faint, oblique brownish or dusky bars; body nearly uniform light tan to brown, without lateral stripe or dark brown saddle posterior to soft dorsal fin; fewer gillrakers, modally 25, range from 23 to 27.
U. bensasi (Schlegel)

3*b*. Lower lobe of caudal fin with 6 or 7 narrow, brown, oblique bars, and the upper lobe with 3; body dark tan above, light tan below with a brown, horizontal stripe on midside and a dark brown saddle on caudal peduncle just posterior to soft dorsal fin; more gillrakers, modally 28, range 27 to 29_____**U. asymmetricus**, new species

2*b*. Pectoral rays number 15 or 16; vertical scale rows range from 36 to 38; peritoneum light to silvery; upper and lower lobes of caudal fin with 3 oblique, brownish black bars on the smaller specimens (68, 69 mm.) increasing to 5 bars on the larger specimens; bars more pronounced on lower lobe; body light tan, possibly with light colored median stripe; without dark saddle over caudal peduncle; gillrakers range from 26 to 29.
U. parvus Poey

1*b*. Dorsal spines VIII, the first spine minute.

4*a*. Total number of gillrakers range from 26 to 32; pectoral rays number 15 to 18; peritoneum brown to black.

5*a*. Caudal fin transparent to dusky, without dark bars; chin barbels long, 58 to 82 percent of head length in large specimens (over 85 mm.); barbel when extended posteriorly usually extends beyond vertical drawn through posteriormost point of preopercle.
U. sulphureus Cuvier and Valenciennes

5*b*. Caudal fin with oblique dark bars on upper lobe; chin barbels short, 46 to 66 percent of head length; barbel when extended posteriorly not reaching vertical drawn through posteriormost point of preopercle.

6*a*. Lower lobe of caudal fin transparent to dusky, without dark, oblique bars; a pale to yellow, median horizontal stripe on side of body, often faintly developed, or obscure_____**U. moluccensis** (Bleeker)

6*b*. Lower lobe of caudal fin with 2 to 3 dark oblique bars, the outer bar widest and more intensely colored; a light colored median and dorsolateral, horizontal stripe on body usually present.
U. vittatus (Forskål)

4*b*. Total number of gillrakers range from 19 to 25; pectoral rays number 12 to 15; peritoneum silvery to transparent, sometimes with scattered, fine, brownish spots.

7*a*. Scales small, 36 to 38 vertical rows on body, 7 rows below lateral line; a faint, tan colored median and dorsolateral, horizontal stripe on body, often completely faded_____**U. arge** Jordan and Evermann

7*b*. Scales large, 28 to 32 vertical rows on body, 6 rows below lateral line; a conspicuous dark brown median stripe on body always present.

8*a*. A dark brown saddle just posterior to base of soft dorsal fin almost always present; two additional saddles through spinous and soft dorsal fins sometimes evident; spotting or blotches absent on body;

upper lobe of caudal fin with 6 brown, oblique bars in adult specimens of about 80 mm. in length, 4 to 5 bars in juveniles of about 50 mm.; lower lobe of caudal with 6 to 7 such bars in adults, 4 to 6 in juveniles; second spine of spinous dorsal fin usually longest; dark spots or blotches on spinous dorsal fin almost always faded; barbels long, usually reach vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 62 to 72 ..... **U. luzonius** Jordan and Seale

8*b*. Dark brown saddle just posterior to base of soft dorsal fin faint, usually not visible; saddles through fins absent; numerous, distinct, small brown spots on cheeks and sides of body to belly; upper lobe of caudal fin almost always with 4 to 5 brown, oblique bars in adults over 80 mm. in length, 3 or 4 in juveniles less than 80 mm. (see table 3); lower lobe with 5 or 6 brown, oblique bars in adults, 4 or 5 in juveniles; fourth spine of spinous dorsal fin longest or about equal to third; dark spots or blotches on spinous dorsal fin almost always conspicuous; barbels short, not reaching vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 52 to 68 .. **U. tragula** Richardson

8*c*. Dark brown saddle just posterior to base of soft dorsal fin faint or completely obscure; saddles through fins absent; a few small dusky spots on sides of head, almost completely absent on sides of body to belly but with large, irregular, dusky to blackish blotches on body; upper and lower lobes of caudal fin with 3 or 4 dusky to black, oblique bars in adults over 80 mm. in length, 3 in juveniles; third spine of spinous dorsal fin longest or about equal to fourth spine; dark blotches on spinous dorsal fin almost always conspicuous; barbels short, not reaching vertical drawn through most posterior portion of preopercular margin; barbel length in percent of head length ranges from 50 to 64 ..... **U. oligospilus**, new species

Upeneus bensasi (Temminck and Schlegel)

PLATE 13, FIGURE A

Mullus bensasi Temminck and Schlegel, 1843, pt. 2, p. 30, pl. 11, fig. 2 (type locality, Nagasaki).—Boeseman, 1947, p. 43.

Upeneoides guttatus Day, 1867, p. 938, (type locality, Madras?); 1876, p. 121.

Upeneoides japonicus Steindachner and Döderlein, 1884, p. 22 (type locality, Tokyo, Kochi, and Tango, Japan) (not *Mullus japonicus* Houttuyn, 1782, p. 334).

Upeneoides tokisensis Steindachner and Döderlein, 1884, p. 22 (name in synonymy, specimens from Tokyo).

Specimens studied.—One hundred fifteen specimens, ranging in length from 37 to 148 mm., from the following localities: Japanese area, 16 USNM collections, 42 specimens; Formosa, 3 USNM collections, 21 specimens; Philippine Islands, 8 USNM collections, 52 specimens.

Description.—Dorsal rays, VII–i,8(65), the first spine longest (two abnormal specimens with some irregularly developed spines, VIII–i,8 and VI–i,8, the first spine in both specimens also longest; pectoral rays 13.8: 13 to 14 (44); vertical scale rows 29.4: 29 to 31

(25); scale rows above lateral line 3 (7); scale rows below lateral line 6.1: 6 to 7 (15); total number of gillrakers 25.0: 23 to 27 (38); length of longest raker in longest filament about 1.1 to 1.3 (6).

Peritoneum brown to blackish; preorbital scales present; barbels long, extending beyond preopercular margin, barbel length in percent of head length 64 to 84 (35); first dorsal spine longest.

Color in alcohol.—Head and body uniform tan to brown above and light tan below; some dusky pigmentation on outer portion of soft dorsal fin in larger specimens and two faint, dusky, horizontal bars sometimes seen in smaller ones, 40 to 60 mm. in length; lower lobe of caudal fin dusky, the tip of the rays transparent to light tan, the smaller specimens have a lengthwise dusky streak through middle portion of lobe; 3 faint oblique brownish to dusky bars on upper lobe in larger specimens and 2 bars in smaller ones about 40 mm. in length; remainder of fins transparent to uniform light tan.

Geographical distribution.—This species has been reported from the East African coast eastward through the East Indies and Philippines, and northward to Formosa, east China, Ryukyu Islands, and southern Japan. It has not been reported from the islands of Oceania.

Remarks.—There is reason to suspect that more than one species was involved in certain literature references to this species. Day (1876, p. 121, pl. 30, fig. 5) gives a high pectoral fin ray (15) and lateral line scale count (32 to 34), shows 4 oblique bars on the lower lobe as well as the upper lobe of the caudal fin, and 2 rows of red spots on the body. These are not characteristic of *bensasi*. Day listed and illustrated 7 spines on the dorsal fin. His account may include or represent an undescribed species related to *bensasi* or to a species of the *vittatus* group (*vittatus*, *sulphureus*, *moluccensis*).

The account by Snyder (1907, p. 97, fig. 3) agrees with our specimens, especially in respect to the number of dorsal spines (7) and the absence of bars on the lower lobe of the caudal fin. His description of color in life is contradictory to that of Day (1876) and Smith (1949, p. 229, pl. 27, fig. 562). Fowler (1933, p. 321, fig. 27) and Smith (op. cit.) list the number of dorsal spines as variable, 5 to 8 and 6 to 8 respectively, but each figure a specimen with 7 spines, the first small spine, typical of the *vittatus* and *tragula* group, being absent.

In the Western Indo-Pacific (East Africa, India) this species may be represented by another form entirely distinct from that of the Philippine-Japan area. *U. bensasi* was not listed by Herre and Montalban (1928) nor by Weber and de Beaufort (1931).

The length of the barbel compared with body length in four size-groups is shown in table 6. The data are too meager to conclude that any appreciable differences exist. There is no population divergence indicated from an inspection of the gillraker and vertical scale counts separated by geographical localities.

TABLE 6.—*Length of barbel in four size-groups, and the number of gillrakers and vertical scale rows, by locality, in* Upeneus bensasi

Standard length in mm.	Barbel length in percent of head length										
	64	66	68	70	72	74	76	78	80	82	84
41–60			1	2			1				
61–80	1	1		2	2	1	2	1			
81–100			2	3		3	1				
Over 100				2	1	2	5			1	1

Locality	Gillrakers					Vertical scale rows		
	23	24	25	26	27	29	30	31
Philippines	2	2	4	2	2	4	1	
Japan	2	4	11	4	1	9	3	3
Formosa			1	2		2	3	

Upeneus asymmetricus, new species

PLATE 13, FIGURE B

Upeneus tragula Fowler, 1933, p. 339 (in part).

Holotype.—USNM 154659, a female specimen 76 mm. in standard length, collected March 24, 1909, at Pandanon Island, east of Cebu, Philippine Islands, by the *Albatross* Expedition.

Paratypes.—USNM 154660, 2 specimens, 73 and 81 mm., taken with holotype and having same data; USNM 154661, 1 specimen, 101 mm., collected April 15, 1908, at Catbalogan, Samar, Philippine Islands, by the *Albatross* Expedition.

Description.—This description is based on the holotype and three paratypes listed above. The counts are recorded for the holotype and followed in parentheses by the range of counts for the paratypes. Certain characters are compared with other species of the genus in tables 1 and 2.

Dorsal rays VII–i,8 (VII–i,8), the first spine longest; pectoral rays ii,11 (ii,11 to ii,12); vertical scale rows 28 (29–30); scale rows above lateral line 2 (2–3); scale rows below lateral line 6 (5–6); total number of gillrakers 27 (28–29); length of longest raker in longest filament 1.4 (1.3–1.5).

Measurements, expressed in thousandths of the standard length, are given for the holotype and paratypes in table 7.

Peritoneum silver brown; preorbital scales present; barbels of average length, extend beyond eye but not reaching preopercular margin, and barbel length in percent of head length 58 to 66; first dorsal spine longest.

Body slightly slab-sided; jaws nearly horizontal; snout rounded; pectoral fins pointed; anal slightly falcate; caudal fin deeply forked.

TABLE 7.—*Measurements of* Upeneus asymmetricus *expressed in thousandths of the standard length*

Characters	Holotype USNM 154659	Paratype USNM 154660	Paratype USNM 154660	Paratype USNM 154661
Standard length, mm	76	81	73	101
Body:				
depth (approximate)	238	----------	232	232
width (approximate)	145	143	136	144
Head:				
length	290	287	279	277
depth	192	189	184	178
Caudal peduncle:				
length	279	251	241	228
least depth	96	98	88	94
Interorbital, least bony width	82	79	69	84
Snout, length	99	103	104	112
Orbit, length	74	78	75	67
Upper jaw, length	105	101	98	105
Barbel, length	184	178	195	188
Spinous dorsal fin, depressed length	214	198	196	203
Pectoral fin, length	209	210	200	212
Pelvic fin, length	210	214	196	197
Anal fin, depressed length	165	178	169	192
Tip of snout to origin of spinous dorsal fin	370	356	368	364
Tip of snout to origin of anal fin	621	615	639	655

Color in alcohol.—Head and body light tan, darker tan above and ligher below; a brown, horizontal stripe, its width about one-half diameter of eye extends from junction of gill opening with body to area just above midbase of caudal fin; a dark brown saddle on caudal peduncle just posterior to soft dorsal fin, its width equals least depth of peduncle and extends ventrally to lateral line; traces of brown color pattern indicating that probably two more saddles existed through soft dorsal and spiny dorsal fins; a small, dark spot at origin of spiny dorsal and soft dorsal fins and one dorsally on peduncle, at first procurrent caudal ray; head and body dorsally above lateral line with a "salt and pepper" coloration.

Spiny dorsal fin with 4 rows of faint tan spots forming horizontal bars; soft dorsal with 3 narrow, brown, horizontal bars; pelvic fins with traces of 3 or 4 bars; caudal fin with 3 narrow, oblique brown bars on upper lobe, the clear interspaces more than twice width of bar; lower lobe with 6 or 7 brown oblique bars, more or less spotlike and not on the two outermost developed rays (lower lobe on USNM 154661 malformed and small); areas on caudal fin just above and below base with a fine, brownish spot; pectoral and anal fins transparent.

Named *asymmetricus* in reference to the unusually reduced number of oblique bars on the upper lobe of the caudal fin.

Geographical distribution.—At present, only known by the type specimens listed above from the Philippine Islands.

Remarks.—The number of oblique caudal bars, more than twice as many on the lower lobe as on the upper, and their narrow width coupled with the absence of the small first dorsal spine, low number of pectoral rays, low vertical scale row count, dark lateral stripe,

dark saddle posterior to soft dorsal, and moderate-to-short barbels best characterize this species.

Upeneus sulphureus Cuvier and Valenciennes

PLATE 13, FIGURE C

Upeneus sulphureus Cuvier and Valenciennes, 1829, p. 450 (type locality, Antjer Straits of Sundra).—Bleeker, 1877, pl. (3) 393, fig. 4.—Smith, 1949, p. 229, pl. 28, fig. 563.—Fowler, 1933, p. 330.

Upeneus bivittatus Cuvier and Valenciennes, 1831, p. 520 (type locality, Coromandel).

Mullus subvittatus Temminck and Schlegel, 1843, p. 30 (type locality, Japan).—Boeseman, 1947, p. 43.

Upeneoides sulphureus Bleeker, 1849, p. 63.—Day, 1876, pt. 1, p. 120, pl. 30, fig. 3.—Herre and Montalban, 1928, p. 103, pl. 3, fig. 1.

Mulloides pinnivittatus Steindachner, 1870, p. 624 (type locality, Nagasaki).

Upeneoides belaque Fowler, 1918a, p. 40, fig. 16 (type locality, Philippines).

Specimens studied.—Two hundred seventeen specimens, ranging in length from 48 to 132 mm., from the following localities: Zanzibar, USNM 12614, 3 specimens, 72 to 79 mm., received from the British Museum; East Indies Islands, four USNM collections totalling 10 specimens; Philippine Islands, 36 USNM collections totalling 200 specimens; China, USNM 94814, one specimen, 132 mm.; Okinawa, USNM 71838, one specimen, 107 mm.; Fiji Islands, Suva, USNM 66069, one specimen, 91 mm.; Pacific, USNM 83115, one specimen, 89 mm., Wilkes Expedition.

Description.—Dorsal rays VIII–i,8(48), the first spine minute; pectoral rays 15.8: 15 to 17 (58); vertical scale rows 35.4: 34 to 37 (44); scale rows above lateral line 3 (10); scale rows below lateral line 7 (27); total number of gillrakers 29.4: 26 to 32 (43); rakers comparatively long and slender, length of longest raker in longest filament averages about 1.1 (6).

Peritoneum dark, uniform light brown to blackish brown; preorbital scales absent; barbels show considerable variation in length and are longer in larger specimens (table 8), usually extending beyond preopercular margin in specimens over 85 mm. in standard length, barbel length in these larger specimens in percent of head length 58 to 82 (73 specimens); range of barbel length in percent of head length, all specimens, 50 to 82 (84 specimens); third dorsal spine slightly longer than second or fourth.

Color in alcohol.—Head and body silvery tan to golden tan, darker brown dorsally and light silvery to golden tan below.

Spinous dorsal with three blackish horizontal bars located near base, middle and outer parts of fin, and separated from each other by whitish bars; the outer black bar is the most intensely developed

279126—54——3

and is somewhat blotched; soft dorsal with three dusky to black bars, usually less intense than those of first dorsal and separated by three light or whitish bars often completely faded; caudal fin with some dusky near tips of rays, especially near fork; pectoral, pelvic, and anal fins clear.

Geographical distribution.—From East Africa eastward through the East Indies, Philippines, and certain island groups of western Oceania (Fiji, USNM 66069; New Hebrides, Herre, 1936, p. 210), and northward to Japan.

TABLE 8.—*Length of barbel in* Upeneus sulphureus

Standard length in mm.	Barbel length in percent of head length																
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
41–60	2	----	3	1	----	1	1	2	6	5	2	2	----	----	----	----	----
61–80	2	1	2	----	----	----	----	2	3	4	----	1	2	1	----	----	----
81–100	----	1	----	----	----	1	1	2	----	1	2	4	3	2	3	1	1
Over 100	----	----	----	----	----	----	----	1	1	1	2	2	----	3	3	2	2

Remarks.—Illustrations of this species in "life colors" show considerable differences in the development and intensity of the bars on the dorsal fins and general body coloration, even those completed by recent artists (Smith, 1949, pl. 28, fig. 563; Herre and Montalban, 1928, p. 103, pl. 3, fig. 1). These differences may be associated with state of preservation, size, or perhaps sexual dimorphism.

The recognition of *Upeneus subvittatus* Temminck and Schlegel by Synder (1907, p. 101) is probably entirely erroneous in view of the recent account by Boeseman (1947, p. 43) on the reexamination of the type material and on my examination of a specimen collected by Jordan and Snyder at Wakanoura, Japan (see "Remarks" in description of *tragula*).

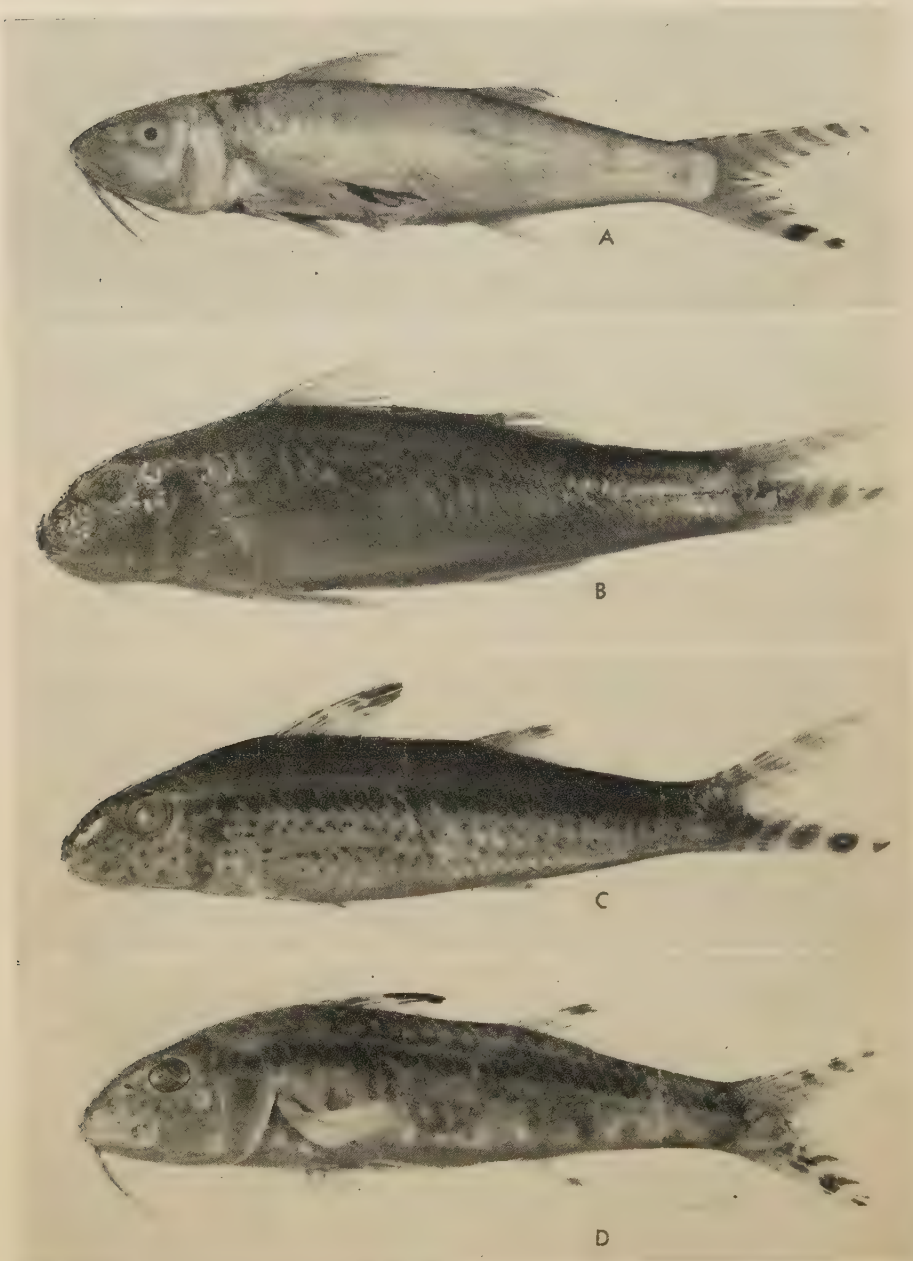
Upeneus moluccensis (Bleeker)

PLATE 13, FIGURE D

Upeneoides moluccensis Bleeker, 1855, p. 409 (type locality, Amboina).—Seale, 1914, p. 68, pl. 392, fig. 1.—Herre and Montalban, 1928, p. 101, pl. 6, fig. 1.
Upeneoides dubius Kner, 1865, p. 67.
Upeneoides fasciolatus Day, 1868a, p. 151 (type locality, Madras).
Upeneoides sulphureus Day, 1876, p. 120 (in part).
Upeneus moluccensis Bleeker, 1877, pl. (2) 392, fig. 1.—Fowler, 1933, p. 328.
Upenoides (error) *moluccensis* Herre and Montalban, 1928, p. 101.

Specimens studied.—Twenty-one specimens, ranging in length from 49 to 125 mm. from the following localities: East Indies Islands, Borneo, Sandakan Bay, USNM 138638, 6 specimens, 66 to 74 mm.; Java, USNM 72694, one specimen, 82 mm.; Philippine Islands, nine USNM collections totalling 10 specimens, taken chiefly by the *Alba-*

A, *Upeneus bensasi* (Temminck and Schlegel), USNM 71356, 85 mm., Shimizu, Suruga Bay, Japan; B, *U. asymmetricus*, new species, holotype, USNM 154659, 76 mm., Pandanon Island, Philippines; C, *U. sulphureus* Cuvier and Valenciennes, USNM 145207, 93 mm., Parang, Mindanao Island, Philippines; D, *U. moluccensis*, (Bleeker), USNM 138629, 94 mm., Balayan Bay, Luzon Island, Philippines; E, *U. vittatus* (Forskål), USNM 106850, 147 mm., Iloilo, Panay Island, Philippines.



A, *Upeneus arge* Jordan and Evermann, USNM 115685, 213 mm., Canton Island, Phoenix Islands; B, *U. luzonius* Jordan and Seale, USNM 106829, 81 mm., Iloilo, Panay Island, Philippines; C, *U. tragula* Richardson, USNM 145233, 105 mm., Luzon Island, Philippines; D, *U. oligospilus*, new species, paratype, USNM 147995, 124 mm., Tarut Bay, Persian Gulf.

tross Philippine Expedition; Japan, Kagoshima, Satsuma, USNM 71354, 2 specimens, 106 and 125 mm. (Samoan Islands, USNM 41559, 2 specimens, 78 and 79 mm., questionable identification).

Description.—Dorsal rays VIII–i,8(15), the first spine minute; pectoral rays 16.0: 15 to 18 (20); vertical scale rows 34.5: 33 to 36 (13); scale rows above lateral line 3: (7); scale rows below lateral line 7: (8); total number of gillrakers 28.9: 27 to 31 (20); length of longest raker in longest filament 1.0 to 1.4 (5).

Peritoneum uniform light brown to dark brown; preorbital scales absent; barbels extend to area between eye and preopercular margin, and barbel length in percent of head length 48 to 64 (21 specimens); second and third dorsal spines about equal in length and these only slightly greater than fourth spine.

Color in alcohol.—Head and body pale to brown above and silvery to light tan below; a sharp horizontal, lemon-yellow stripe persists on the body in some specimens after about 50 years of preservation and extends from eye to area just above midbase of caudal fin.

The spiny dorsal fin has three dark brown bars separated by three transparent to whitish bars, and the tips of the second to fourth spines are whitish; soft dorsal with brown bars separated by two transparent to whitish bars with the tips of the longest rays sometimes in white; caudal fin with three to four brownish to dusky oblique bars on the upper lobe, the lower lobe clear to dusky, especially near tips of rays; pectoral, pelvic, and anal fins clear.

Geographical distribution.—From India (Day, 1868 and 1876) eastward through the East Indies to the Philippines and possibly Oceania (Samoan Islands); from Japan (Kagoshima) southward to Australia (Kner, 1865).

Remarks.—Certain characters given in the account and shown on the illustration of *Mullus dubius* Temminck and Schlegel (1843, p. 30, pl. 11, fig. 3) can be associated, in part, to those of *U. moluccensis*. The narrow, yellow stripe on the body, the oblique bars only on the upper lobe of the caudal fin, and the bars on the dorsal fins as shown for *dubius* are characteristic of *moluccensis*. Seven spines in the spiny dorsal fin were listed for *dubius*, but a report on the type by Boeseman (1947, p. 44) revealed eight. Boeseman found the type specimen in a very bad state of preservation and the color and color pattern were faded. He recently examined the dentition of the type of *dubius* for me and found the teeth of the jaws to be rather stout and large and clearly separated from each other. No teeth were on the vomer or palatines. Thus *Mullus dubius* Temminck and Schlegel must definitely be referred to the genus *Parupeneus* Bleeker (1868, p. 344). We may never know if more than one species was involved in their description.

Upeneus vittatus (Forskål)

PLATE 13, FIGURE E

Mullus vittatus Forskål, 1775, p. 31; (type locality, Djedda, Red Sea).—Lacépède, 1802, p. 382, pl. 14, fig. 1.—Shaw 1803, p. 616, pl. 89.
Mullus bandi Shaw, 1803, p. 615 (type locality, Vizagapatam).
Upeneus vittatus Cuvier and Valenciennes, 1829, p. 448.—Bleeker, 1877, pl. (2) 392, fig. 3.—Fowler, 1933, p. 334, fig. 31; 1949, p. 95.—Smith, 1949, p. 228, pl. 27, fig. 561.
Upeneus bitaeniatus Bennett, 1831, p. 59 (type locality, Mauritius).
Hypeneus vittatus Cantor, 1850, p. 1017.
Upeneoides vittatus Gunther, 1859, p. 397.—Day, 1876, p. 120, pl. 30, fig. 2.—Sauvage, 1891, p. 219 (not pl. 27, fig. 2).—Herre and Montalban, 1928, p. 105, pl. 4, fig. 1.
Upeneoides caeruleus Day, 1868b, p. 194 (type locality, Madras); 1876, p. 121.
Upeneoides vittatus Klunzinger, 1870, p. 741 (error).
Upeneoides philippinus Fowler, 1918a, p. 37, fig. 15 (type locality, Philippines).

Specimens studied.—One hundred fifty specimens, ranging in length from 56 to 226 mm., from the following localities: Zanzibar, USNM 154172, 1 specimen, 67 mm., received from British Museum; Mauritius, USNM 19956 and 19985, 19 specimens collected by Col. N. Pike; East Indies, USNM 72693, 88032, 88033, 145288, and 145290, 6 specimens from Sumatra, Java, Borneo, and Bouro Islands; Philippines, 32 USNM collections, 93 specimens collected by the *Albatross* Philippine Expedition, The Philippine Commission, Mearns and McGregor; Japan, Okinawa, USNM 71679, 4 specimens, collected by the *Albatross*; Marianas, USNM 124088 and 139854, 7 specimens, collected by Frey, McElroy, and Markley; Fiji Island, USNM 66070, 1 specimen; Samoan Islands, 3 USNM collections, 10 specimens; Society Islands and Tuamotus Islands (Low Archipelago), USNM 89045 and 133844, 3 specimens; Marquesas Islands, USNM 89750, 6 specimens, collected by the Pinchot Expedition.

Description.—Dorsal rays VIII–i,8(48) the first spine minute (one specimen with 7 spines, the last abnormally small, the first minute and typical); pectoral rays 16.1: 15 to 17 (68); vertical scale rows 35.0: 33 to 37 (49); scale rows above lateral line 3 (13); scale rows below lateral line 6.9: 6 or 7 (23); total number of gillrakers 28.2: 26 to 31 (68); length of longest raker in longest filament averages about 1.2 (6).

Peritoneum dark brown to silvery brown (in many of the smaller specimens the peritoneum is brownish with a silvery cast); preorbital scales absent; barbels extend beyond eye but not beyond preopercular margin, barbel length in percent of head length 46 to 66 (74 specimens); third dorsal spine equal to or slightly greater than second.

Color in alcohol.—Head and body light tan to golden tan, darker above and lighter tan to silvery below; two to three faint, dark, horizontal stripes situated dorsolaterally above middle of body.

Spinous dorsal fin with two blackish horizontal bars, one on outer and one near middle of fin; the outer bar passes through outer third of 2nd to 5th spines, and is colored an intense black; a whitish bar between these bars; soft dorsal with three dusky to black bars or marks, a short mark near the posterior basal area, a long horizontal bar at middle of fin and a narrow dusky tip on the 1st to 3rd rays; caudal fin with oblique, dusky to black bars, 3 or 4 on the upper lobe and 2 or 3 on the lower; sometimes the tip of the longest (outer) rays of the upper lobe are slightly touched in black (these I have considered as a bar in my counts); outer bar on lower lobe with more intense black and twice as wide as other bars on caudal; this particular bar never at tip of lower lobe (only one specimen with tip of the lower lobe touched in blackish, see table 9); two nearly horizontal bars extend from near fork of caudal to areas just above and below midbase of fin and were not included in counts of the total number of oblique bars of the caudal fin; pectorals, pelvics, and anal fins transparent.

TABLE 9.—*Relationship of number of bars on caudal fin with increase in body length, and the length of chin barbel by four size-groups in* Upeneus vittatus

Total length in mm.	Number of bars on lobes of caudal fin		
	Upper 3 Lower 2	Upper 4 Lower 2	Upper 4 Lower 3
50–74	19		
75–99	23		
100–124	5	2	
125–149	2	5	1
150–174	5	3	
175–199	1		
200–224	1		

Standard length in mm.	Barbel length in percent of head length										
	46	48	50	52	54	56	58	60	62	64	66
41–60						1					
61–80			2		3	1	2	4	3	1	
81–100			1	1	5	4	7	3	2		
Over 100	2		3	6	6	3	8	3		2	1

Geographical distribution.—A widely ranging species, occurring from the Red Sea eastward through the East Indies and islands of Oceania to the Low Archipelago, and reported from Japan southward to Australia. Fowler (1933, pp. 334–335) has given an almost complete list of references, but many of these include only lists of species and such records cannot be accurately appraised. This species has not been reported from the Hawaiian and Johnston Islands.

Remarks.—There is no evidence of any change in barbel length with increase in body length from the statistics presented in table 9. The relationship of the number of bars on the caudal fin with increase in body length is also shown in table 9. At most, one more bar is sometimes formed on the upper lobe in the larger specimens and this bar is merely a touch of blackish at the tips of the outer rays. Only one specimen had such a mark on the lower lobe.

TABLE 10.—*Certain counts of* Upeneus vittatus, *by locality*

Locality	Gillrakers						Lateral line scales				
	26	27	28	29	30	31	33	34	35	36	37
Zanzibar	1						1				
Mauritius		3	4		1				3	2	
East Indies			2					1	1		
Philippines	1	7	13	7				9	11	3	
Japan		1	2	1				1		2	
Marianas		3	3	1				1	1	1	
Fiji				1				1			
Samoan				5	4			1	2	5	
Society, Tuamotus			1		1	1			5		
Marquesas		2	3		1				3	2	1

Very little intraspecific differentiation was found in the subfaunal areas from an analysis of color and color pattern, body proportions, and meristic counts. In table 10 the statistics of the number of gillrakers and vertical scale rows are segregated by locality, from the east African area eastward. Some of these localities represent subfaunal areas of the Indo-Pacific region, and although a maximum separation of about 12,000 miles exists between the extreme localities, the data does not suggest any significant population divergence.

Upeneus arge Jordan and Evermann

PLATE 14, FIGURE A

Upeneus arge Jordan and Evermann, 1903, p. 187 (type locality, Honolulu); 1905, p. 264, pl. 39.—Fowler, 1928, p. 227, pl. 19,c; 1931, p. 336; 1938, pp. 224, 285; 1940, p. 777; 1949, p. 96.—Jenkins, 1902, p. 456.—Schultz, 1943, p. 128.—Snyder, 1904, p. 527.

Upeneoides arge Fowler, 1922, p. 83.—Jordan, Evermann, and Tanaka, 1927, p. 674.—Jordan and Jordan, 1922, p. 52.

Specimens studied.—Eleven specimens, ranging in length from 164 to 250 mm.: Hawaiian Islands, USNM 50667 (holotype), 17999, 52817, 55100, 83358, 83449, 88194, and 151524, 9 specimens; Phoenix Islands, USNM 115685, 2 specimens.

Description.—Dorsal rays VIII–i,8(11), the first spine minute, pectoral rays 13.9: 13 to 14 (12); vertical scale rows 37.3:37 to 38 (10); scale rows above lateral line 3 (6); scale rows below lateral line

7 (6); total number of gillrakers 22.3:21 to 24(11); length of longest raker in longest filament 1.5 to 1.7 (4).

Peritoneum transparent; preorbital scales absent; barbels extend beyond eye to about the preopercular margin and barbel length in percent of head length 64 to 74 (10 specimens); second dorsal spine equal to or slightly longer than third.

Color in alcohol.—Head, body, and barbels light tan to pale above, lighter on chin and belly; two very faint horizontal stripes on body, dusky in color, and about as wide as pupil; one stripe is located dorsolaterally and the other medially.

Spinous dorsal with some dusky on outer membrane, remainder clear or faintly dusky, soft dorsal with three narrow, transverse bars colored diffuse brown; pectoral, pelvic, and anal fins clear; caudal fin with 6 oblique brown to black bars on upper lobe and 5 on lower lobe; lobes tipped in brownish black; the outer two bars on lower lobe about twice as wide as those on upper lobe; two nearly horizontal streaks near fork of caudal, just above and below median line.

Geographical distribution.—The Hawaiian Islands and various island groups of Oceania. Our specimens are from the Hawaiian and Phoenix Islands. Fowler (1928, p. 227) reports the species from the Palmyra, Caroline, and Gilbert Islands.

Remarks.—Fowler (1928, p. 227) conjectured that *U. arge* "may eventually be found inseparable" with *U. vittatus*. He pointed out that *vittatus* has slightly smaller scales than *arge* but he overlooked such trenchant characters as the differences in the color of the peritoneum, number of pectoral fin rays, and number of gillrakers.

Upeneus luzonius Jordan and Seale

PLATE 14, FIGURE B

Upeneus luzonius Jordan and Seale, 1907, p. 25, fig. 9 (type locality, Cavite).—Weber and de Beaufort, 1931, p. 372.—Fowler, 1933, p. 325, fig. 28.
Upeneus sundaicus Evermann and Seale, 1907, p. 88.
Upeneoides luzonius Seale, 1910, p. 279.—Herre and Montalban, 1928, p. 97, pl. 1, fig. 1.

Specimens studied.—Sixteen specimens from the Philippines ranging in length from 25 to 119 mm., from the following Islands: Panay, USNM 106829, 102649, 106793, 106846, and 154201, 7 specimens; Luzon, USNM 53067 (cotypes) and 138658, 5 specimens; Linapacan, USNM 138659, 3 specimens, USNM 154200, 1 specimen.

Description.—Dorsal rays VIII–i,8(11), the first spine minute; pectoral rays 14.1:14 to 15 (10); vertical scale rows 31.3:31 to 32 (8); scale rows above lateral line 3 (5); scale rows below lateral line 6 (5); total number of gillrakers 20.4:19 to 22 (9); length of longest raker in longest filament averages about 1.5 (5).

Peritoneum transparent; preorbital scales present; barbels long, extend to preopercular margin, barbel length in percent of head length 62 to 72 (10 specimens); second dorsal spine longest.

Color in alcohol.—Head and body tan to dark brown on upper half of body, lighter below; smaller specimens lighter tan than larger specimens; a dark brown stripe extends from snout through eye to area just above midbase of caudal fin, being below the lateral line on anterior part of body and above lateral line on posterior portion; width of lateral stripe about three-fourths diameter of eye; lateral stripe most pronounced in adults and more conspicuous than illustrated by Fowler (1933) or Herre and Montalban (1928); body with three dark brown saddles, their width about 1 to 2 times greater than diameter of eye; first saddle passes through midbase of spinous dorsal fin, the second through midbase of soft dorsal, and the third passes over caudal peduncle just posterior to soft dorsal fin; saddles extend ventrally to the lateral line and are more conspicuous in smaller specimens; the two anteriormost saddles almost completely faded in the larger specimens.

Spinous dorsal dusky on upper half, three very faint, transverse, dusky bars in specimens about 50 mm. in length; soft dorsal with 2 faint, dusky, transverse bars in smaller specimens and 3 in the larger ones; pectoral fin with about 3 to 5 barely discernible vertical bars on one adult specimen, fins of other specimens completely clear; pelvic fin with a faint brownish blotch or bar in specimens about 50 mm. in length, fins of largest specimens clear; anal fin with a faint dusky bar in smaller specimens, completely clear in larger specimens; caudal fin with 2 to 7 oblique, dusky-to-brown bars on each lobe, the bars increasing in number with increase in length (table 3); the bars on the lower lobe broader, wider than the clear interspaces, and more intensely developed than those of the upper lobe; bars on upper lobe almost as wide as clear interspaces; bars on fins in varying degrees of intensity, the caudal bars being most evident.

Geographical distribution.—East Indies (Seale, 1910; Herre and Montalban, 1928) and Philippine Islands.

Remarks.—The differences in the color pattern between Fowler's illustration (1933, fig. 28) and that of Herre and Montalban (1928, pl. 1, fig. 1) are undoubtedly associated with the state of preservation and the sizes of specimens used for the illustrations. Fowler indicated his specimen was a "young" one. The low number of caudal bars, fairly conspicuous bars on the dorsal fins, and well-developed saddles, as he has illustrated, are characteristic of the smaller sizes. Herre and Montalban illustrate about 7 bars on each lobe of the caudal, which is characteristic of specimens about 100 mm. in length (table 3).

This species is closely related to *U. tragula*, and the smaller specimens of each species are easily confused with each other. The geographic range of *tragula* completely overlaps that of *luzonius* and both have been collected together. The young of *tragula* often have a moderately developed saddle on the caudal peduncle, generally lack the spotting characteristic of the adults, and the color pattern of the fins may be nearly obscure; consequently, these specimens superficially resemble *luzonius*. The characters listed in table 11 are most helpful in distinguishing between these species.

TABLE 11.—*Characters distinguishing* Upeneus luzonius *and* U. tragula

Character	*luzonius*	*tragula*
Pectoral fin rays.	92 percent with 13 or fewer, range 12 to 14.	All with 14 or 15.
Total number of gill-rakers.	20.4 (19 to 22).[1]	22.8 (21 to 25).
Barbel length in percent of head length.	66.6 (62 to 72).	59.2 (52 to 68).
Brown spots on head and body.	Always absent.	Usually well developed and numerous, sometimes faint to obscure.
Dark brown saddles on body.[2]	3 in young, 2 or 1 (the posteriormost one) in adults; sometimes all are almost completely faded.	Faint to moderately developed saddle over caudal peduncle in young and juvenile specimens, often inconspicuous or entirely faded in adults.
Pigmentation of:		
(*a*) dorsal fins.	2–3 faint dusky bars on each but often completely faded.	Each almost always tipped in a large blackish irregular blotch, remainder of fin blotched with black, white, or clear.
(*b*) pelvics and anal fins.	Clear in adults; each with a faint transverse bar in small specimens.	Almost always with dark brown spots arranged in 2 to 3 rows.
(*c*) caudal fin.	Dark brown oblique bars nearly uniformly narrow and elongate; developed with almost equal intensity on each lobe; usually occurring in equal numbers on the lobes; 1 bar more per lobe at a given length (table 3).	Dark brown, oblique bars, elongate anteriorly becoming oval-shaped posteriorly, especially outer two bars on lower lobe; bars on lower lobe conspicuously more intensely developed; usually 1 more bar on the lower lobe; 1 bar less per lobe at a given length (table 3).

[1] The mean is followed by the range of variation in parentheses.
[2] All descriptions of color and color pattern refer to preserved specimens.

Upeneus tragula Richardson

PLATE 14, FIGURE C

Upeneus tragula Richardson, 1846, p. 220 (type locality, Canton).—Fowler, 1933, p. 339 (in part).
Upeneoides variegatus Bleeker, 1849, p. 64 (type locality, Batavia).
Upeneoides kiushiuana Döderlein, *in* Steindachner and Döderlein, 1884, p. 22 (name only; type locality, Kagoshima).
Upeneus subvittatus Snyder, 1907, p. 101.
Upeneoides tragulus Snyder, 1912, p. 503.

Specimens studied.—One hundred eighty-eight specimens, ranging in length from 29 to 227 mm., from the following localities: Zanzibar, USNM 12614, 1 specimen, 83 mm., received from the British Museum; East Indies Islands, USNM 72695, 145263, and 145624, 6 specimens, 79 to 188 mm.; Philippine Islands, 64 USNM collections, 115 specimens, most taken by the *Albatross* Philippine Expedition; China, USNM 9128, 145265, and 148413, 3 specimens; Japan and Okinawa, 9 USNM collections, 13 specimens; Palau Islands, USNM 154202, 47 specimens collected by Eugenie Clark, July 1949; Australia (New South Wales), USNM 59957 and 82984, 3 specimens.

Description.—Dorsal rays VIII–i,8(35), the first spine minute; pectoral rays 13.0: 12 to 14 (77); vertical scale rows 30.0: 28 to 32 (48); scale rows above lateral line 3 (9); scale rows below lateral line 6 (37); total number of gillrakers 22.8: 21 to 25 (57); length of longest raker in longest filament averages about 1.5 (5).

Peritoneum transparent to silvery; preorbital scales present; barbels extend to area between eye and preopercular margin, barbel length in percent of head length, 52 to 68 (58 specimens); third dorsal spine slightly longer or about equal to fourth.

Color in alcohol.—Dorsal portion of head and body pale or dusky to tan; chin and belly lighter; barbels pale; a tan to blackish brown horizontal stripe extends from tip of snout, through eye, along middle of body to base of caudal fin; width of stripe somewhat variable, about 0.5 to 1.0 in diameter of eye; chin, cheeks, operculum, and body below lateral line with numerous circular to irregularly shaped spots, colored tan to dark brown or dusky; these spots are more irregular, larger, blotchlike and less intense on some of our larger specimens over 160 mm.; spots sometimes faint or completely absent. (Specimens of the large collection recently taken in the Palau Islands lack well-developed spots almost entirely, whereas many specimens taken nearly a half century ago by the *Albatross* Expedition in the Philippines have well-defined spots. These island groups are contiguous, geographically, and such color variations may be associated with different methods employed in collecting and preserving rather than racial differences.) Dorsal portion of head and body usually

finely speckled with brown; lower sides of body with 8 to 10 faint, dusky blotches or bars, variable in size and often completely obscure; an inconspicuous dusky to brown saddle, sometimes obsolete, just posterior to soft dorsal fin, its width about two-thirds length of base of soft dorsal.

Spinous dorsal fin with large, brown-to-blackish, irregular spot on outer third, a clear or whitish spot anteriorly on basal third followed by a large, brownish-black, irregular spot midbasally, remainder of fin transparent; soft dorsal transparent with three brown to black marks, an outer spot, a horizontal stripe near middle, and a short stripe near base on anterior third; pectoral fin transparent with one circular, brown to dusky spot near base; pelvic fin transparent with 6 to 9 circular, brown to black spots arranged in 2 to 3 rows, often completely faded; anal fin transparent with 2 to 3 bars (or spots, depending on condition of fading), brown to blackish colored and almost parallel to base; caudal fin transparent with 2 to 6 oblique bars on the upper lobe and 2 to 7 on the lower lobe, colored brown to black, the number of bars increase with increase in length (table 3); lower lobe usually has one more bar than the upper lobe, and coloration of bars more intense; the caudal bars first appear as spots which become oval shaped (specimens under 50 mm.) and then elongate to form the definitive oblique bars.

Geographical distribution.—Represented in the U. S. National Museum collections from East Africa, eastward, in the East Indies and Philippines to the Palau Islands and from southern Japan to New South Wales, Australia. Although abundant in the Philippine Islands (note specimens studied above; Herre and Montalban, 1928, p. 99; Fowler, 1933, p. 339; and Weber and de Beaufort, 1931, p. 368), this species apparently becomes rare eastward, in certain islands of Oceania, and has not been reported for most of the island groups. In addition to the excellent collection made by Eugenie Clark from the Palau Islands, USNM 154202, Herre (1935, p. 165) also listed it. Seale (1935, p. 362) listed specimens from the Solomon and Samoan Islands, all of which were small. Herre (1936, p. 209) also reported on two small specimens from the Solomons, but his description was based on Philippine material. Jordan and Seale (1906, p. 273) reported it, too, from the Samoan Islands. Schultz (1943) did not collect it in either the Phoenix or Samoan Islands, nor was it taken by the recent intensive collecting by Schultz and others in collaboration with the U. S. Navy project in the Marshall Islands (1946–1947). Superficial examinations, particularly of the small specimens, could easily lead to misidentifications, especially with such forms as *U. luzonius* and *vittatus*. Specimens reported from the Solomons and

Samoan Islands should be reexamined. *U. tragula* has not been reported from the Hawaiian faunal area.

Remarks.—The change and variation in length of barbel with increase in body length was investigated (table 12) but no appreciable difference was found.

This species appears constant in body proportions, meristic counts, and coloration over its range. Counts of the number of gillrakers and vertical scale rows were segregated by locality (table 12) and these data do not even suggest any population divergence.

U. tragula is most closely related to *oligospilus* and *luzonius* and compared with them in their descriptive accounts. Table 3 shows the relationship of the number of oblique bars on the caudal fin with increase in body size in these three species.

TABLE 12.—*Number of gillrakers and vertical scale rows, by locality, and length of chin barbel in four size-groups in* Upeneus tragula

Locality	Number of gillrakers					Number of vertical scale rows				
	21	22	23	24	25	28	29	30	31	32
Zanzibar		1					1			
East Indies	1		5				2	2	1	1
Philippines	3	4	21	2		2	7	9	6	2
China		1							1	
Japan	3	4		1			1	2	1	
Palau			6	3	2		3	3	2	1

Standard length in mm.	Barbel length in percent of head length								
	52	54	56	58	60	62	64	66	68
41–60					3				1
61–80	1				2	5	3		
81–100		1		6	3	3	1	1	
Greater than 100	3	3	3	8	5	2	2		

A specimen of *U. subvittatus* Snyder (1907, p. 101), Stanford University Natural History Museum No. 20156, collected by Jordan and Snyder at Wakanoura, Japan, is without question *U. tragula.* The following counts for this specimen almost all fall on the modes of the frequency distributions given above for *tragula*: pectoral fin rays 28, gillrakers 2, 4+1+11, 5 totaling 23, barbel length in head length 58 percent, vertical scale rows 29. Other important characters as the silvery peritoneum, dark lateral stripe on body, dark dorsal saddles, and oblique bars on caudal fin are also identical to those of *tragula.* Snyder gave a "length" of 175 mm. in contrast to my measure of 228 mm. (standard length) for the above specimen. This discrepancy is not explainable.

Upeneus oligospilus, new species

PLATE 14, FIGURE D

Upeneus tragula Blegvad and Løppenthin, 1944, p. 135, pl. 7, fig. 3.

Holotype.—USNM 153988, a female specimen 115 mm. in standard length, collected April to June, 1948, at Tarut Bay, Ras Tannura, Persian Gulf, by Donald S. Erdman.

Paratypes.—USNM 147995, 11 specimens, 70 to 160 mm., taken with the holotype and having the same data.

Description.—This description is based on the holotype and paratypes listed above. The counts are given for the holotype, followed in parentheses by the average and range of counts taken from the 11 paratypes. When counts for the paratypes are identical with those of the holotype, only one number is given. Certain characters are compared with other species of the genus in tables 1–3.

Dorsal rays VIII–i,8 (VIII–i,7.8: VIII–i,7 to i,8), the first spine minute; pectoral rays 14 (13.6: 13 to 14); vertical scale rows 30 (30.2: 29–31); scale rows above lateral line 3; scale rows below lateral line 6; total number of gillrakers 23 (22: 20–23), rakers short and blunt, length of longest raker in longest filament 1.5 to 2.3.

Measurements, expressed in thousandths of the standard length, are given for the holotype and paratypes in table 14.

Peritoneum transparent, slightly dusky in certain areas of some specimens; preorbital scales present; barbels of average length, extend beyond eye but not to margin of preopercle, barbel length in percent of head length 50 to 64; fourth dorsal spine equal to or slightly smaller than third.

Margins of pectoral fins round, spiny dorsal fin round, soft dorsal and anal slightly falcate, caudal fin deeply forked.

Color in alcohol.—Head and body pale with dusky to blackish blotches of irregular shape and size; body darker above, with scattered dusky pigmentation, and lighter below; a dark stripe from tip of snout through eye to area just above midbase of caudal fin; diffuse dusky spots on snout and cheeks and a few on sides of body in some specimens but absent on belly; light or silvery spots on scales of body, the diameter about one-third to one-half vertical length of scale; a weakly developed, dark saddle just posterior to soft dorsal fin, nearly obsolete in most of the specimens.

Outer third of spinous dorsal with dense black blotch, remainder of fin blotched in black, whitish or clear; soft dorsal with an irregular black spot near tip, a black spot or incomplete bar near base and some scattered, dusky spots; pectoral fin with a small, black spot near base, remainder transparent; pelvic fin with 2 to 3 rows of circular, black spots, about 6 in all; anal fin with 2 faint, elongate dusky marks,

remainder of fin clear; caudal fin with black, oblique bars on both lobes, varying from 2 on the upper and 3 on the lower in the smallest specimen and 4 bars on both lobes in the larger specimens (table 3); bars on the lower lobe more distinct and slightly wider than those of the upper; a diffuse, blackish, irregular, and broken spot near midbase of caudal fin.

Named *oligospilus* in reference to the faint, scattered, dusky spots on the sides of the body.

Geographical distribution.—Known from the Persian Gulf and probably the Gulf of Oman (Blegvad and Løppenthin, 1944, p. 136). It may occur more widely, especially along the Indian coast, than is now known.

Remarks.—This species is related to *luzonius* and *tragula;* considerably more to the latter species. It differs from *tragula* chiefly in the reduced number of oblique bars on the caudal fin (table 3) and in the reduced number of dark spots on the sides of the body, which are decidedly more diffuse and larger, and absent on the belly. It differs from *tragula* also in certain other characters, some of which are difficult to measure for statistical inspection. Of these it is worthy to mention the deeper, more robust body, shorter fins, especially the pectorals and pelvics (see table 13), slightly longer head, and higher modal count of the pectoral fin rays (table 1).

TABLE 13.—*Coloration in life of* Upeneus oligospilus *and of* U. tragula

Item	*U. oligospilus*[1]	*U. tragula*[2]
	(Persian Gulf)	(Philippines)
Head and body.	Head brownish dorsally; side of body below lateral stripe with bluish green cast; abdomen silvery with red tinge.	Grayish yellow; body ventrally white flushed with roseate.
Horizontal stripe.	Orange.	Dusky to brown.
Spots on head and body.	Scattered, irregular, vivid, vermilion spots, quickly fading in alcohol.	Conspicuous uniform brown spots; sparingly to thickly spotted and persist in preservation.
Spiny dorsal fins.	Vermilion bars.	Upper third black with circular, yellow spots, and lower portion with two dusky bars.
Caudal fin.	Vermilion bars; narrower.	Dusky bars; wider.

[1] Blegvad and Løppenthin (1944)
[2] Herre and Montalban (1928)

Blegvad and Løppenthin (1944, p. 135) attributed the differences in color of their specimens, when compared with the descriptions of Weber and de Beaufort (1931, p. 368) and Day (1876, p. 121), as apparently due to the preserved state of the material. This may have been so in part, but it is now realized that two species were involved. A description and figure of the color in life of *oligospilus* is given by Blegvad and Løppenthin (op. cit., pl. 7, fig. 3) in their account of *U. tragula*, and when it is compared with the color in life of *tragula* given by Herre and Montalban (1928, p. 100, pl. 2, fig. 2) notable differences are found. There are some obvious errors in both illustrations, such as the diagrammatic arrangement of the bars on the fins of *tragula* by Herre and Montalban, as well as the excessively uniform distribution of the spots on the body and the omission of the dark brown saddle just posterior to the soft dorsal fin. The illustration of Blegvad and Løppenthin appears to have much of an artist's touch but lacks details. No pigmentation is shown on the outer portion of the spiny dorsal fin by them, but in preserved specimens this area has a most conspicuous black blotch. The salient differences of color in life between *oligospilus* and *tragula* as recorded by the above authors are summarized in table 13.

TABLE 14.—*Measurements of* Upeneus oligospilus *expressed in thousandths of standard length*

Characters	Holotype	11 Paratypes[1]
Standard length, mm	115	105 (70–160)
Body:		
depth	238	241 (213–261)
width	157	157 (136–173)
Head:		
length	320	306 (280–323)
depth	195	203 (184–241)
Caudal peduncle:		
length	230	260 (247–277)
least depth	102	101 (93–107)
Interorbital, least bony width	82	78 (74– 81)
Snout, length	130	117 (113–131)
Orbit, length	71	69 (59– 78)
Upper jaw, length	137	129 (119–139)
Barbel, length	207	179 (152–204)
Spinous dorsal fin, depressed length	210	214 (194–236)
Pectoral fin, length	195	202 (167–217)
Pelvic fin, length	197	197 (160–216)
Anal fin, depressed length	174	176 (166–196)
Tip of snout to origin of spinous dorsal fin	378	375 (366–390)
Tip of snout to origin of anal fin	662	648 (610–697)

[1] In paratypes the average values are followed by the range of variation in parentheses.

TABLE 15.—*Length of pelvic fins in two species of* Upeneus, *expressed as a percentage of the head length*

Species	Percent																
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
oligospilus	1	----	----	----	1	1	2	1	2	1	2	1	----	----	----	----	----
tragula	----	----	----	----	----	----	----	1	1	9	7	13	8	8	7	3	1

Upeneus parvus Poey

Upeneus parvus Poey, 1853, p. 226 (type locality, Cuba).—Poey, 1852, pl. 17, fig. 4.—Norman, 1922, p. 534.—Longley and Hildebrand, 1941, p. 142.
Upeneoides parvus Stahl, 1882, pp. 76, 162.

Specimens studied.—Six specimens from the Western Atlantic ranging in length from 68 to 119 mm., from the following localities: Cuba, USNM 37576, collected by F. Poey, 1885, 2 specimens; Puerto Rico, Anasco Bay, USNM 128263 and 144555, collected by V. Barnes, Jr., 1943–1944, 3 specimens; Tortugas, Fla., USNM 92051, collected by W. H. Longley, 1931, 1 specimen.

Description.—Dorsal rays VII–i,8, the first spine longest; pectoral rays 15.5: 15 to 16 (6); vertical scale rows 37.2: 36 to 38 (4); scale rows above lateral line 3: (4); scale rows below lateral line 6.6: 6 to 7 (3); total number of gillrakers 27.4: 26 to 29 (6); length of longest raker on longest filament about 1.2 (4).

Peritoneum light, transparent to slightly silvery; preorbital scales present; barbels extend to posterior margin of preopercle; barbel length in percent of head length 62 to 78 (6 specimens).

Color in alcohol.—Head and body light tan. One specimen shows evidence of a light colored median stripe on body and possibly a finer one below it. Caudal fin with dark, oblique bars, more pronounced on lower lobe; 3 bars on the upper and lower lobes in the smaller specimens and 4 or 5 on each lobe of the larger ones. Traces of bars or marks on the spinous and soft dorsal fins. Remainder of fins clear. No photograph was included because of the poor condition of the specimens.

Geographical distribution.—Known from the following localities in the Western Atlantic, where it is apparently rare: Cuba, Tobago (Norman, 1922), Puerto Rico, and Tortugas.

Remarks.—In Fowler's description of *Upeneus phillipsi* (1918b, p. 5, fig. 1, type locality, Corson's Inlet, Cape May County, New Jersey) he suggested that it may be "allied, if not identical" with *Upeneus parvus*. Examination of the holotype of *U. phillipsi* Fowler revealed this species to be a juvenile specimen, 52 mm. in standard length, of *Mullus auratus* Jordan and Gilbert.

Critical generic and specific characters were inaccurately recorded by Fowler. He lists and figures 8 spines in the first dorsal fin; states that the dentition of the upper jaw consists of at least a row of low, simple teeth, and that the vomer and palatines have fine teeth; lists 30 scales in the lateral line to base of caudal fin and 16 pectoral rays. I find 7 spines in the first dorsal fin, no teeth on the upper jaw and those of the vomer and palatines coalesced to form a palatal tooth patch which is characteristic of the genus *Mullus*, 34 or 35 vertical scale rows along the lateral line to hypural base, and 15 pectoral rays for each fin.

The following characters were also recorded from the type specimen: total number of gillrakers, 22; barbels extend slightly beyond margin of preopercle; peritoneum light colored to slightly dusky; 2 barlike marks on spinous dorsal fin and 3 on soft dorsal; caudal fin with 3 dark oblique bars on each lobe (tips of lobe now broken off); a salmon-colored stripe on body along lateral line and prolonged through eye with coarse flecks of salmon color on the lower portion of sides of body (observed in life by collector, R. J. Phillips).

The characters given above clearly place *U. phillipsi* in the synonymy of *Mullus auratus*.

References

AGASSIZ, J. L. R.

1846. Nomenclatoris zoologici. Index universalis . . . , 393 pp.

BENNETT, EDWARD TURNER.

1831. Observations on a collection of fishes from the Mauritius, with characters of new genera and species. Proc. Zool. Soc. London (1831), pt. 1, pp. 32, 59–61, 126–128, 165–169.

BLEEKER, PIETER.

1849. Bijdrage tot de kennis der Percoïden van den Malajo-Molukschen Archipel, met beschrijving van 22 nieuwe soorten. Verh. Batavia Gen., vol. 22, 64 pp.

1855. Zesde bijdrage tot de kennis der ichthyologische fauna van Amboina. Nat. Tijdschr. Nederlandsch-Indië, vol. 8, pp. 391–434.

1868. Notice sur le *Parupeneus bifasciatus* (*Mullus bifasciatus* Lacép.) de l'Île de la Réunion. Versl. Gewone Vergad. Akad. Amsterdam, ser. 2, vol. 2, pp. 342–348.

1876. Systema Percarum revisum. Arch. Néerlandaises Sci. Exact. Nat., vol. 11, pt. 1, pp. 247–288; pt. 2, pp. 289–340.

1877. Atlas ichthyologique des Indes Orientales Néerlandaises . . . , vol. 9, pp. 1–80, pls. 355–360, 363–420.

BLEGVAD, H., and LØPPENTHIN, B.

1944. Fishes of the Iranian Gulf, 247 pp., 135 figs., 12 pls.

BOESEMAN, MARINUS

1947. Revision of the fishes collected by Burger and von Siebold in Japan, 242 pp., 5 pls.

CANTOR, THEODORE

1850. Catalogue of Malayan fishes. Journ. Asiatic Soc. Bengal, vol. 18, pp. i–xii + 983–1443, pls. 1–14.

CUVIER, GEORGES, L. C. F. D., and VALENCIENNES, ACHILLE

1829. Histoire naturelle des poissons, vol. 3, 500 pp.

1831. Histoire naturelle des poissons, vol. 7, 531 pp.

DAY, FRANCIS

1867. On some new or imperfectly known fishes of India. Proc. Zool. Soc. London (1867), pp. 935–942.

1868a. On some new or imperfectly known fishes of India. Proc. Zool. Soc. London (1868), pp. 149–156.

1868b. On some new fishes from Madras. Proc. Zool. Soc. London (1868), pp. 192–199.

1876. The fishes of India, vol. 1, 320 pp., 68 pls.

EVERMANN, BARTON W., and SEALE, ALVIN
1907. Fishes of the Philippine Islands. Bull. U. S. Bur. Fish., vol. 26 (1906), pp. 49–110, 22 figs.

FORSKÅL, PETRUS
1775. Descriptiones animalium avium, amphibiorum, piscium . . . , 164 pp., 43 pls.

FOWLER, HENRY W.
1918a. New and little-known fishes from the Philippine Islands. Proc. Acad. Nat. Sci. Philadelphia, vol. 70, pp. 2–71, figs. 1–27.
1918b. Fishes from the Middle Atlantic States and Virginia. Occ. Pap. Mus. Zool. Univ. Michigan No. 56, pp. 1–19, pls. 1, 2.
1922. A list of Hawaiian fishes. Copeia, No. 112, pp. 82–84.
1928. The fishes of Oceania. Mem. Bishop Mus., vol. 10, iii+540 pp., figs. 1–82, pls. 1–49.
1931. The fishes of Oceania. Mem. Bishop Mus., vol. 11, suppl. 1, No. 5, pp. 313–381, figs. 1–7.
1933. *In* Contributions to the biology of the Philippine Archipelago and adjacent regions. U. S. Nat. Mus. Bull. 100, vol. 12 (The fishes of the families Banjosidae . . . Mullidae . . .), 465 pp., 32 figs.
1938. The fishes of the George Vanderbilt South Pacific Expedition, 1937. Acad. Nat. Sci. Philadelphia, Monogr. No. 2, v+349 pp., pls. 1–12.
1940. The fishes obtained by the Wilkes Expedition, 1838–1842. Proc. Amer. Philos. Soc., vol. 82, No. 5, pp. 733–800, figs. 1–76.
1949. The fishes of Oceania. Mem. Bishop Mus., vol. 12, suppl. 3, No. 2, pp. 37–186.

GUNTHER, ALBERT
1859. Catalogue of the fishes in the British Museum, vol. 1 (Acanthopterygii), 524 pp.

HERRE, ALBERT W. C. T.
1935. A check list of the fishes of the Pelew Islands. Journ. Pan-Pacific Res. Inst., vol. 10, No. 2, pp: 163–166.
1936. Fishes of the Crane Pacific Expedition. Field Mus. Nat. Hist. Publ. 353, Zool. Ser., vol. 21, 472 pp., 50 figs.

HERRE, ALBERT W., and MONTALBAN, HERACLIO R.
1928. The goatfishes, or Mullidae, of the Philippines. Philippine Journ. Sci., vol. 36, No. 1, pp. 95–136, pls. 1–6.

HOUTTUYN, MARTIN
1782. Beschrijving van eenige Japansche visschen en andere zeeschepselen. Verh. Hollandsche Maatsch. Wet., Haarlem, vol. 20, pt. 2, pp. 311–350.

JENKINS, OLIVER P.
1903. Report on collections of fishes made in the Hawaiian Islands, with descriptions of new species. Bull. U. S. Fish. Comm. (1902), vol. 22, pp. 417–511, figs. 1–50, pls. 1–4.

JORDAN, DAVID S.
1919. The genera of fishes. Leland Stanford Junior Univ. Ser., pt. 2, pp. ix, 163–284, xiii.

JORDAN, DAVID S., and EVERMANN, BARTON W.
1903. Descriptions of new genera and species of fishes from the Hawaiian Islands. Bull. U. S. Fish. Comm., vol. 22 (1902), pp. 161–208.
1905. The aquatic resources of the Hawaiian Islands. I. The shore fishes of the Hawaiian Islands, with a general account of the fish fauna. Bull. U. S. Fish. Comm., vol. 23 (1903), pt. 1, pp. 1–574, figs. 1–229, colored pls. 1–73; pls. 1–65.

JORDAN, DAVID S., EVERMANN, BARTON W., and TANAKA, SHIGEHO.
1927. Notes on new or rare fishes from Hawaii. Proc. California Acad. Sci., ser. 4, vol. 16, No. 20, pp. 649–680, pls. 22–24.

JORDAN, DAVID S., and JORDAN, ERIC K.
1922. A list of the fishes of Hawaii, with notes and descriptions of new species. Mem. Carnegie Mus., vol. 10, No. 1, 92 pp., 4 pls., 7 figs.

JORDAN, DAVID S., and SEALE, ALVIN.
1906. The fishes of Samoa . . . . Bull. U. S. Bur. Fish., vol. 25 (1905), pp. 173–455, pls. 38–53, figs. 1–111.
1907. Fishes of the Islands of Luzon and Panay. Bull. U. S. Bur. Fish., vol. 26 (1906), pp. 1–48, figs. 1–20.

KLUNZINGER, CARL B.
1870. Synopsis der Fische des Rothen Meeres. Pt. 1. Percoiden-Mugiloiden. Verh. Zool.-Bot. Ges. Wien, vol. 20, pp. 669–834.

KNER, RUDOLF.
1865–1867. Reise der österreichischen Fregatte "Novara" um die Erde in den Jahren 1857–1859 . . . , Zoologischer Theil, Fische, 1–3 Abtheilung, 433 pp., 16 pls.

LACÉPÈDE, BERNHARD G. DE LA
1802. Histoire naturelle des poissons . . . , vol. 3, 558 pp., 34 pls.

LACHNER, ERNEST A.
1951. Studies of certain apogonid fishes from the Indo-Pacific, with descriptions of three new species. Proc. U. S. Nat. Mus., vol. 101, No. 3290, pp. 581–610, pls. 17–19, fig. 105.

LONGLEY, WILLIAM H., and HILDEBRAND, SAMUEL F.
1941. Systematic catalogue of the fishes of Tortugas, Florida, with observations on color, habits, and local distribution. Carnegie Inst. Washington Publ. 535 (Pap. Tortugas Lab., vol. 34), 331 pp., 34 pls.

NORMAN, J. R.
1922. Fishes from Tobago. Ann. Mag. Nat. Hist., vol. 9, pp. 533–536.

POEY, FELIPE
1852–1853. Memorias sobre la historia natural de la Isla de Cuba. Vol. 1, pp. 201–280 (1853); pls. 15–22 (1852).

RICHARDSON, JOHN
1846. Report on the ichthyology of the seas of China and Japan. Rep. Fifteenth Meeting British Assoc. Adv. Sci. (1845), pp. 187–320.

SAUVAGE, HENRI E.
1891. Poissons. *In* Grandidier, Histoire physique, naturelle et politique de Madagascar, vol. 16, text, 543 pp., Atlas, 50 pls.

SCHULTZ, LEONARD P.
1943. Fishes of the Phoenix and Samoan Islands collected in 1939 during the expedition of the U. S. S. *Bushnell*. U. S. Nat. Mus. Bull. 180, x+316 pp., 9 pls., 27 figs.

SEALE, ALVIN

1910. Fishes of Borneo, with descriptions of four new species. Philippine Journ. Sci. (1910), sec. D, vol. 5, No. 4, pp. 263–288, pls. 1–4.

1914. Fishes of Hongkong, Philippine Journ. Sci., vol. 9, No. 1, pp. 59–79.

1935. The Templeton Crocker Expedition to western Polynesian and Melanesian Islands, 1933. Proc. California Acad. Sci., ser. 4, vol. 21, No. 27, pp. 337–378, pls. 20–23.

SHAW, GEORGE.

1803. General zoology or systematic natural history . . . , vol. 4, pt. 2, 632 pp., 92 pls.

SMITH, J. L. B.

1949. The sea fishes of South Africa, 550 pp., 103 pls., 1245 figs.

SNYDER, JOHN O.

1904. A catalogue of the shore fishes collected by the steamer *Albatross* about the Hawaiian Islands in 1902. Bull. U. S. Fish. Comm., vol. 22 (1902), pp. 513–1538, pls. 1–13, figs. 1–24.

1907. A review of the Mullidae, surmullets, or goatfishes of the shores of Japan. Proc. U. S. Nat. Mus., vol. 32, No. 1513, pp. 87–102, figs. 1–3.

1912. The fishes of Okinawa, one of the Riu Kiu Islands. Proc. U. S. Nat. Nat. Mus., vol. 42, No. 1913, pp. 487–519, pls. 62–70.

STAHL, AUGUSTIN

1882. Fauna de Puerto-Rico. Catalogo del gabinete zoológico del Dr. A. Stahl, en Bayamon (Pto.-Rico) precedido de una classification sistematica de los animales que corresponden á esta fauna. San Juan. 249 pp.

STEINDACHNER, FRANZ

1870. Ichthyologische Notizen. X. SitzBer. Akad. Wiss. Wien, vol. 61, pp. 623–643, pls. 1–5.

1901. Fische aus dem Stillen Ocean. Ergebnisse einer Reise nach dem Pacific (Schauinsland 1896–97). Denkschr. Akad. Wiss. Wien, vol. 70, pp. 483–521, 6 pls.

STEINDACHNER, FRANZ, and DÖDERLEIN, LUDWIG

1884. Beiträge zur Kenntniss der Fische Japan's. II. Denkschr. Akad. Wiss., vol. 48, pp. 1–40, pls. 1–7.

TEMMINCK, COENRAAD J., and SCHLEGEL, H.

1843. Pisces, *in* Siebold, Fauna Japonica . . . , pt. 2, pp. 21–72, 160 pls.

WEBER, MAX, and DE BEAUFORT, L. F.

1931. The fishes of the Indo-Australian archipelago, vol. 6, 448 pp., 81 figs.

WHITLEY, G. P.

1943. Poisonous and harmful fishes. Australia Council Sci. Ind. Res., Bull. 159, 28 pp., 3 pls., 16 figs.

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